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Technology Needs Assessment and associated action plan for climate change mitigation and adaptation in Nigeria's most vulnerable economic sectors

Market Assessment Report

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Contents

- 1. Introduction 3**
- 2. Context..... 4**
- 3. Agriculture and land use 6**
 - 3.1 Sectoral assessment 6
 - 3.2 Prioritized technologies 7
 - 3.3 Assessment of barriers..... 7
 - 3.4 Identified action plans for the agriculture and land use sector..... 8
- 4. Energy 10**
 - 4.1 Sectoral assessment 10
 - 4.2 Prioritized technologies 11
 - 4.3 Assessment of barriers..... 11
 - 4.4 Identified action plans and activities for the energy sector 12
- 5. Industry and commerce 14**
 - 5.1 Sectoral assessment 14
 - 5.2 Prioritized technologies 15
 - 5.3 Assessment of barriers..... 15
 - 5.4 Identified action plans and activities for the industry and commerce sector..... 16
- 6. Cross-cutting opportunities and challenges 18**
 - 6.1 Cross-cutting opportunities..... 18
 - 6.2 Cross-cutting challenges 18



1. Introduction

The objective of this assignment is to develop a comprehensive Technology Needs Assessment (TNA) and associated action plan for Nigeria's climate change mitigation and adaptation. This comprehensive TNA and action plan enables Nigeria to meet its climate change mitigation and adaptation priorities and targets, as well as provide the guidance required by Nigeria in developing its climate finance pipeline. These documents will be used by Nigeria to implement its climate action plans, and to propose financing requests toward climate finance sources such as the Green Climate Fund (GCF). To achieve the objective above, relevant technologies that can contribute to Nigeria's climate objectives were identified through a series of desktop review and consultations, especially in the three priority sectors, namely, agriculture and land use, energy, and industry and commerce. The identified technologies were then discussed and evaluated during the regional workshops, and later validated during the validation workshop. This has led to the development of Technology Action Plans (TAPs) for each sector that will enable the implementation and dissemination of prioritized technologies. The technology action plans for the prioritized technologies include the necessary activities to introduce the technologies, financing options, and monitoring and evaluation methods.

In this context, to successfully implement the prioritized technologies, it is important to have an understanding on the current state of each market and sector, including its relation to climate change as well as potential barriers in disseminating technologies. This report, therefore, provides a brief overview of the Nigerian context discussing its climate change challenges and relevant policies. Then, the report will discuss the sectoral challenges, prioritized technologies, barriers, and identified action plans and activities per sector. This information can serve as basis for successfully deploying the technologies and implementing the action plans, which can contribute to the country's development and help achieve Nigeria's commitments in climate change mitigation and adaptation, as well as help Nigeria establish its climate finance pipeline.



2. Context

Nigeria is the largest economy in sub-Saharan Africa with a population of approximately 216 million.¹ Geographically, Nigeria is the 14th largest country in Africa with 910,770 sq.km, in which land area accounts for 910,769 sq.km and water area accounts for 13,000 sq.km.² Nigeria has one of the largest river systems in the world including the Niger Delta, which is the largest river delta in Africa and the third largest in the world, while most of Nigeria's land is covered by savannas and plains.³ Furthermore, Nigeria is also characterized by three distinct climate zones, a semi-arid climate in the northern regions, a tropical savannah climate in most of the central region, and a tropical monsoon climate in the southern regions.⁴

Nigeria faces several climate change challenges that need to be addressed, especially in its vulnerable sectors. This is highlighted in Nigeria's Third National Communication (TNC) to the United Nations Framework Convention on Climate Change (UNFCCC) in March 2020 and other relevant documents. In particular, the TNC emphasizes the importance of technology transfers for Nigeria to address the impacts of climate change. Nigeria is a relatively small contributor to global greenhouse gas (GHG) emissions, with a total net national emissions amounting to 609,784 GgCO₂ equivalent in 2016. According to the 2016 GHG inventory, Agriculture, Forestry and Other Land Use (AFOLU) sector was by far the largest source of emissions, with 60.1 percent, followed by the energy sector with 33.9 percent. Even though total net emissions remain low from a global perspective up to this point, addressing emissions from vulnerable sectors is critical for Nigeria as the TNC estimates that Nigeria should see its emissions increase by more than 58 percent until 2035 under a business-as-usual (BAU) scenario.

Nigeria's economy has diversified in recent years, and the economy grew by an average of 7 percent from 2000 to 2014. Even though Nigeria's real gross domestic product (GDP) growth rate fell to 2.7 percent in 2015, the country has enjoyed stable macroeconomic growth primarily led by the oil sector. Yet, significant challenges remain such as food insecurity, high unemployment, and lack of access to energy, which are hampering the country's path to sustainable development. As a result, 4 out of 10 Nigerians live below the poverty line with lack of access to basic services such as water and electricity. The agriculture sector remains the largest sector in the economy as it contributes to 25.9 percent of the country's GDP while employing 70 percent of Nigeria's total employment.

However, according to the World Economic Forum's 2022 World Gender Gap Report, Nigeria ranks 123 out of 146 countries on gender equality. As of August 2022, women held 3.6 percent of seats in the lower house of parliament and 7.3 percent of seats in the upper house. Persons with disabilities face environmental, institutional, and social challenges, limiting their opportunities to actively participate in society in general, and in the workforce in specific. In addition, 75 percent of children live in poverty, while 40.1 percent of Nigeria's total population lives below the poverty line. 31 percent of the adult population in Nigeria are illiterate.

Given the number of development and climate challenges, Nigeria has requested the support of Climate Technology Centre and Network (CTCN) and United Nations Industrial Development Organization (UNIDO) for the development of a Technology Needs Assessment (TNA) and associated action plan for climate change mitigation and adaptation. Nigeria is committed to addressing climate change impacts and has been actively engaged in international climate change negotiations since becoming a Party to the UNFCCC in 1994 and ratifying the Kyoto Protocol in 2004. To date, Nigeria has submitted its first (2003), second (2014), and third national

¹ World Bank – Nigeria. 2022. Available at: <https://data.worldbank.org/country/nigeria>

² Ibid.

³ National Geographic – Nigeria. 2022.

⁴ World Bank Climate Knowledge Portal – Nigeria. 2021.



communications (2020) as well as its first Biennial Update Report (BUR) in 2018. Nigeria has recently updated its NDC and its second BUR and submitted these documents to the UNFCCC in 2021.

According to Nigeria's updated NDC, Nigeria aims to reduce its emissions 20 percent below the BAU scenario by 2030 unconditionally and 47% below the BAU by 2030 conditional on international support. In its first NDC (2017), specific measures to achieve the country's climate change objectives are identified, ending gas flaring by 2030, installing 13 gigawatt (GW) of off-grid solar photovoltaic (PV), using efficient natural gas electricity generating plants, achieving 2 percent in energy efficiency per year and leading to 30 percent by 2030, shifting to intermodal transport towards mass transportation, improving electricity grid, and implementing climate smart agriculture and reforestation. The first NDC also includes strategies for key sectors that are critical in meeting climate change adaptation objectives in Nigeria. These sectors include agriculture and land use, energy, and industry and commerce, which are also aligned with the three priority sectors in scope of the TNA. To implement these strategies and achieve the country's climate change objectives, however, it is crucial for Nigeria to gain access to climate finance through the TAPs.

For Nigeria's TNA, the three priority sectors were selected in the inception workshop led by the Federal Ministry of Science, Technology and Innovation (FMSTI), in collaboration with Federal Ministry of Environment's Department of Climate Change (FMEnv – DCC) in September 2018. In this regard, the three prioritized sectors are agriculture and land use, energy, and industry and commerce. The three priority sectors are not only key in addressing Nigeria's development challenges but are also climate-sensitive and vulnerable to the impacts of climate change. The following sections will detail the current state of each market, explaining the identified barriers and action plans.

3. Agriculture and land use

3.1 Sectoral assessment

The agriculture sector, including land use and forestry, is a key driver for Nigeria's economy and the overall development of the country, since it is the main source of livelihood for most Nigerians. It is the largest sector and employer of labor, contributing approximately 27 percent to the GDP between October to December in 2020 and employing approximately 70 percent of the country's labor force.⁵ Women make up a significant portion of the labor force, at 75 percent of the agricultural labor force in Nigeria. However, while there is a general lack of knowledge and skills among both women and men farmers when it comes to modern technologies, access to capital, market information and more, gender, poverty, geographical location, and disability status compound these issues.⁶

The sector also experiences direct impacts of climate change and one of the most sensitive sectors to climate change. The climate change impacts for the sector include but not limited to depletion of water resources and unpredictable rainfall patterns, further impacting production system and crop productivity. Under the business-as-usual scenario, it is estimated that agricultural productivity could decline between 10 to 25 percent by 2080.⁷ This loss in productivity would be detrimental to the already constrained food production to meet its domestic demand. Given its vast land, different regions face different climate impacts and need different technologies to mitigate those impacts. This point has been continuously raised by the stakeholders throughout the process of technology selection in the TNA. In this regard, it is essential that necessary measures will be taken to ensure that the sector can address both overall development and climate change challenges.

Nigeria has an abundance of land, approximately 82 million hectares, in which less than half of is currently under cultivation, presenting a transformative opportunity for Nigeria. Despite this potential, the country is also a major importer of food, spending approximately USD 3 to 5 billion annually on food. This excludes technology imports to support agricultural mechanization and food processing. In the crop production sub-sector, increases in crop and livestock production have not kept pace with population growth, resulting in rising food imports and declining levels of national food self-sufficiency.⁸ For the crop production sub-sector, this is a result of heavy reliance on rainfed agriculture, smallholder land ownership, poor planting materials and farm inputs/support such as fertilizer application, weak agricultural extension systems, and subsistence farming which generally lead to low productivity, among others.⁹ For the livestock production, the low productivity is driven by low productive breeds, inadequate access to feeds and grazing lands, lack of processing facilities, low value addition and low technical inputs and extension service support in the management of the livestock and associated diseases.¹⁰ As such, the focus of development in these sub-sectors is to achieve self-sufficiency in production for basic foods, agro-based and other industries.

As for the forestry sub-sector, the sub-sector accounted for 2 percent of the GDP and 8 percent of the agricultural value added over the last two decades. In relation to energy, the overuse of fuelwood driven by population growth in Nigeria is resulting in risk of deforestation. The concern on deforestation or forest degradation has been frequently raised by the stakeholders in the different regions during this TNA process. The gap in demand and supply of energy and related

⁵ Statista. [Contribution of agriculture to GDP in Nigeria from the 3rd quarter of 2019 to the 3rd quarter of 2021](#)

⁶ Federal Ministry of Environment, 2020. National Action Plan on Gender and Climate Change for Nigeria.

⁷ Federal Republic of Nigeria. 2017. INDC.

⁸ FAO. Nigeria at a glance.

⁹ Ibid.

¹⁰ Ibid.

deforestation urgently needs to be addressed through introduction of improved forest management and forest industries as well as introduction of alternatives to fuelwood. Such measures will also mitigate adverse effects of droughts and desertification. The forestry sub-sector is also the highest emitter of GHG emissions in the agriculture and land use sector, accounting for 84 percent of total emissions.

3.2 Prioritized technologies

The agriculture and land use sector is comprised of three prioritized sub-sectors, namely, crop production, livestock production, and forestry. The technologies prioritized under this sector are summarized in the table below. For each sector, 2-3 technologies per sub-sector were prioritized during the validation workshop that took place on August 1st, 2022.

Crop production	<ol style="list-style-type: none"> 1. Climate Smart Agriculture (including drip irrigation) 2. Agricultural biotechnology (including crop diversification and new varieties) 3. Integrated Climate Change Monitoring and Early Warning System
Livestock production	<ol style="list-style-type: none"> 1. Selective breeding via controlled mating 2. Manure management 3. Livestock disease management
Forestry	<ol style="list-style-type: none"> 1. Agroforestry 2. Forest management techniques for mitigation (REDD+) 3. Ecosystem-based adaptation

3.3 Assessment of barriers

The agriculture and land use sector of Nigeria faces the following barriers for the dissemination of prioritized technologies:

Types of Barriers	Description
Political	<ul style="list-style-type: none"> ▪ None
Regulatory	<ul style="list-style-type: none"> ▪ Outdated land tenure system impeding access to land*
Institutional	<ul style="list-style-type: none"> ▪ Insufficient institutional arrangement ▪ Inefficient fertilizer procurement and distribution
Technical	<ul style="list-style-type: none"> ▪ Insufficient technical capacity and facilities* ▪ Limited availability of climate data and land use ▪ Very low level of irrigation development
Financial	<ul style="list-style-type: none"> ▪ High initial investment costs required ▪ Insufficient investment in the sector ▪ Lack of small finance for farmers* High cost of farm inputs
Geographical	<ul style="list-style-type: none"> ▪ None
Market	<ul style="list-style-type: none"> ▪ Limited private sector involvement ▪ Poor access to markets*
Information	<ul style="list-style-type: none"> ▪ Lack of information on all the technologies, available techniques and benefits* ▪ Weak agricultural extension systems
Behavioral	<ul style="list-style-type: none"> ▪ Limited adoption of research findings and technologies ▪ Heavy reliance on rainfed agricultural practice ▪ High usage of wood fuels

*These issues are compounded for women farmers.

Nigeria's economy entered a recession in 2020 due to falling global oil prices and implementing



measures to fight the spread of COVID-19. The impacts of COVID-19 pandemic could further increase the poverty rate and reduce the country's economic and development outcomes. Especially, the agriculture and land use sector where smallholder producers dominate is affected by COVID-19 and related prevention measures such as strict border controls. The impact of the limited international trade leads to several impacts including deteriorated food insecurity, increased prices of farm inputs (e.g.: fertilizers and fodder) and limited exports of wood products.

The sector faces two critical challenges related to sectoral development; the inability to meet domestic food requirements, which is a key factor in the country's food insecurity situation, and the inability to export at quality levels required for market success.¹¹ The two key sectoral challenges are mainly driven by outdated land tenure system that constraints access to land, a very low level of irrigation development, limited adoption of research findings and technologies, high cost of farm inputs, poor access to credit, inefficient fertilizer procurement and distribution, inadequate storage facilities and poor access to markets have all resulted in low productivity, at an average of 1.2 metric tons of cereals/ha, with high postharvest losses and waste.¹² Specifically for the forest sub-sector, deforestation and desertification are also serious challenges that are induced by high-usage of wood fuel, insufficient forest management and lack of sustainable energy resources.

3.4 Identified action plans for the agriculture and land use sector

The implementation action plans for the agriculture and land use sector are as follows:

Action Plan 1: Raising awareness

Action Plan 2: Capacity building

Action Plan 3: Development of enabling environment for private sector engagement

Action Plan 4: Dissemination of technologies

The first action plan aims at raising the awareness of the relevant stakeholders such as government institutions, farmers and local communities, technology developers, end-users, potential investors, and financial institutions. The objective of the second action plan is mainly to strengthen the technical and institutional capacity of relevant government institutions to allow them to make informed decision to design the required gender-responsive policies such as regulations, standards, fiscal instruments and incentives, among others, to support the implementation and dissemination of the technologies. This action plan also involves creating various partnerships among different stakeholders to optimize each expertise and knowledge, as well as networks. The third action plan intends to develop the enabling environment for private sector stakeholders, to encourage them to take-up and scale-up the technologies and measures under each technology. Finally, as opposed to the previous three action plans which focuses on transversal measures applicable for all the technologies, the fourth action plan details the concrete activities needed to disseminate each prioritized technology.

In the agriculture and land use sector, the main users of the technologies are expected to be private sector smallholders and community, and more rarely large-scale national institutions. It will therefore be crucial to provide the right financing conditions/schemes to trigger private sector investments from smallholders for the introduction of new technologies. Under this approach, the government of Nigeria and international partners will mainly provide grant financing related to technical assistance, which include but not limited to awareness raising activities, policy development, technical assistance and capacity building. Furthermore, developing accessible small finance for farmers would catalyze the engagement of smallholders. Given the sector has

¹¹ Federal Ministry of Agriculture and Rural Development. The Agriculture Promotion Policy (2016 – 2020).

¹² FAO. Nigeria at a glance.



a great potential of economic development, it is possible to create bankable and sustainable business models which will attract the private sector investment such as bonds and/or concessional finance. External financing will also be essential to develop the enabling environment for private sector engagement in providing necessary technologies or facilities related to the prioritized technologies. Grants and concessional financing may also be used for blended finance, in order to support local financial institutions in provide financial products which are relevant to the needs of the private sector, especially for smallholder producers.



4. Energy

4.1 Sectoral assessment

The energy sector plays a critical role in supporting the long-term development vision for Nigeria, as it is estimated that approximately 35,000 megawatts (MW) of additional electricity generated on-grid and off-grid is needed for Nigeria's future economic growth. The projected growth rate will demand even greater electricity generation from a combination of sources by 2030. In addition to increasing electricity generation, improving access to electricity is essential to support the proposed modernization and industrialization for development. It is estimated that 70 percent of the population that live in rural areas currently do not have access to the electricity grid. This inadequate access to electricity has had a negative impact on the overall economic growth of Nigeria by placing significant constraints on the productive capacity of micro-entrepreneurs and rural supply chains. On the other hand, increase in economic activity and population growth have significantly increased fuelwood use to meet its energy demand. This is increasingly driving the risk of deforestation and increase in associated GHG emissions.

In supporting the required long-term development needs for Nigeria, the energy sector has objectives for each of its sub-sectors, namely, electricity supply, energy demand, and energy efficiency. For electricity supply, Nigeria aims to increase access to electricity to 75 percent and 90 percent of the population (rural and urban) by 2020 and 2030, respectively, and at least 10 percent of renewable energy mix by 2025. Specific to renewable energy, Nigeria has developed the Renewable Energy Master Plan, which includes installed capacity targets, including 2,000 MW by 2025 for small-hydro, 500 MW of solar by 2025, 200 MW of biomass-based power plant by 2025, and 40 MW of wind energy by 2025. Furthermore, Nigeria aims to achieve universal coverage of 100 percent electrification by 2040.¹³

For energy demand, to address the increasing use of fuelwood driven by growing population, the sector aims at reducing the percentage contribution of fuelwood consumption in the domestic, agricultural, and industrial sectors and to facilitate the use of alternative energy resources to fuelwood. For this sub-sector, the sector also aims to promote biomass as an alternative energy resource especially in the rural areas.

The energy sector also focuses on achieving energy efficiency as part of an effort to achieve cleaner and greener energy, with objectives to increase the share of electricity generated from renewable sources such as solar, wind and biogas, by 1 percent every year compared to 2012 level, reduce electricity generation, transmission and distribution losses from the current level of 15 – 40 percent to less than 10 percent by 2020, replacing all incandescent light bulbs in every home, industry, institution, and establishment with light emitting diodes (LED) and other energy saving lamps by 2025, achieving a broad range of equipment energy efficiency standards and labelling by 2025, and reducing energy-related GHG emissions by 15 percent compared to the 2013 level by 2025.¹⁴

In regard to electricity supply sub-sector, Nigeria has long struggled with poor access to a reliable electricity supply, in which most households and businesses receive less than five hours of electricity per day. This inconsistent electricity supply has driven most businesses to acquire inefficient diesel-powered generators, contributing not only to significant GHG emissions but also leading to the use of more expensive electricity than electricity provided through the grid. The sub-sector currently accounts for 81.9 percent of total emissions of the energy industries category. As such, implementing appropriate technologies to mitigate climate change impacts while supporting the increase in electricity supply would be essential for the sector's overall

¹³ Federal Ministry of Power, Works and Housing. 2016. RESIP.

¹⁴ Federal Republic of Nigeria. 2016. NEEAP.

development.

In the energy demand sub-sector, as mentioned above, energy demand in Nigeria is expected to rise significantly in the coming years as demand from households, which has the largest share of the energy demand, will increase due to growing population. Currently in Nigeria, oil, natural gas, and biomass constitute the main sources of energy. Over 60 percent of the population depend on fuelwood for cooking and other domestic uses. Use of fuelwood, coupled with wide use of inefficient cooking methods, such as open fire, is deteriorating the current state of energy demand in Nigeria. Fuel combustion activities contribute to approximately 65.6 percent of total emissions of the energy sector. Energy efficiency is also identified as a key measure to contribute to Nigeria’s climate change efforts in its NDC. Currently, Nigeria’s residential, commercial, and industrial sectors experience inefficient application and use of electrical appliances, such as lighting, refrigeration, and air conditioning, among others. Achieving energy efficiency has been identified as part of an effort to achieve cleaner and greener energy and reducing energy-related GHG emissions, especially related to electricity generation, transmission, and distribution losses.

4.2 Prioritized technologies

The energy sector is comprised of three prioritized sub-sectors, namely, electricity supply, energy demand, and energy efficiency. The technologies prioritized under this sector are summarized in the table below. For each sector, 2-3 technologies per sub-sector were prioritized during the validation workshop that took place on August 1st, 2022.

Electricity supply	<ul style="list-style-type: none"> 4. Solar PV/Concentrated Solar Power (Solar Thermal) 5. Waste-to-energy (biomass power generation) 6. Carbon Capture and Storage
Energy demand	<ul style="list-style-type: none"> 4. Improved cookstoves 5. Demand-side management 6. Smart grid
Energy efficiency	<ul style="list-style-type: none"> 4. Energy management systems 5. Energy efficient buildings 6. Energy efficiency standards and labels

4.3 Assessment of barriers

The energy sector of Nigeria faces the following barriers for the dissemination of prioritized technologies:

Types of Barriers	Description
Political	<ul style="list-style-type: none"> ▪ The relation between the energy and power sectors is complex, with different political interests among stakeholders
Regulatory	<ul style="list-style-type: none"> ▪ Methodologies to achieve policy targets has improved especially within renewable energy based mini-grid programmes. However, it remains vague to actually support the increase of energy access to address energy demand, energy efficiency and application of other renewable energy sources such as waste to energy.
Institutional	<ul style="list-style-type: none"> ▪ Broad range of stakeholders involved in the energy sector, with each stakeholder having slightly different objectives and appears to have overlapping mandates.
Technical	<ul style="list-style-type: none"> ▪ Insufficient technical capacity ▪ Access to electricity is a challenge, especially in rural areas

Financial	<ul style="list-style-type: none"> Several prioritized technologies are capital-intensive and require significant investments, and government budget is not enough to address this Insufficient financial resources in the energy sector
Geographical	<ul style="list-style-type: none"> Difficult to cater universal services with vast area coverage
Market	<ul style="list-style-type: none"> Abundance of fossil fuels in the market hinders the progress towards a low carbon economy due to some of the identified barriers in policy, regulatory and institutional arrangement
Information	<ul style="list-style-type: none"> Limited information available for the prioritized technologies
Behavioral	<ul style="list-style-type: none"> Despite energy efficiency being an important issue, promotion of energy efficiency behavior is still limited High consumption behavioral patterns and customs remain prevalent, especially among households in rural areas

The Nigerian energy sector faces several challenges. Nigeria is an economically developing nation with some population still lacking access to electricity. Given the country's vast land area, it is necessary to work on different themes such as energy supply and efficiency improvement, reflecting the actual situation of each region. In addition, oil and gas are naturally endowed in Nigeria, which can be an obstacle when promoting low carbonization or energy efficiency improvements from an economic perspective.

In Nigeria, it is critical to improve energy efficiency to meet the country's climate change targets. At the same time, given the country's growing electricity demand, increasing electricity supply is equally important, which creates a challenge when promoting energy efficiency.

Moreover, the technologies listed as priority technologies include technologies that have never been introduced in Nigeria. Securing financial resources to realize this will be an issue. Since it is difficult for Nigeria's domestic energy industry and related beneficiaries to secure project costs, it is necessary to utilize public funding systems such as development financial institutions and international financial institutions.

The impact of COVID-19 on the energy sector is mixed. On the one hand, the outbreak of COVID-19 has led to a decline in oil and gas demand, as well as decrease in oil and gas production, providing an opportunity for Nigeria to shift to clean energy sources. On the other hand, COVID-19 has exacerbated the county's economic recession, resulting in shortages of clean energy technologies, minimized the budget for human capital development in the energy sector, and diminished the overall labor force in the sector.

4.4 Identified action plans and activities for the energy sector

The implementation action plans identified for the energy sector are as follows:

Action Plan 1: Raising awareness

Action Plan 2: Capacity building

Action Plan 3: Development of enabling environment for private sector engagement

Action Plan 4: Dissemination of technologies

The first action plan aims at raising the awareness of the relevant stakeholders such as government institutions, energy-sector stakeholders, technology developers, end-users, potential investors, and financial institutions. The objective of the second action plan is mainly to strengthen the technical and institutional capacity of relevant government institutions to allow them to make informed decision to design the required gender-responsive policies such as



regulations, standards, fiscal instruments and incentives, among others, to support the implementation and dissemination of the technologies. The third action plan intends to develop the enabling environment for private sector stakeholders, to encourage them to take-up and scale-up the technologies and measures under each technology. Finally, as opposed to the previous three action plans which focuses on transversal measures applicable for all the technologies, the fourth action plan details the concrete activities needed to disseminate technologies by sub-sector.

For the energy sector, the main users of the technologies are expected to be private sector stakeholders, including generation and distribution companies, and companies from other industries. It will therefore be crucial to provide the right financing conditions/schemes to trigger private sector investments for the introduction of new technologies. The first set of activities, which includes the capacity building and awareness raising of relevant stakeholders on the prioritized technologies, will be financed by international organizations or bilateral donors in the form of grants. Conducting the necessary assessments and developing pilot projects can also be financed by grants or concessional loans. In regard to the dissemination of technologies, it is preferred that the financing will be led by the private sector, including local financial institutions to establish a sustainable business model for the prioritized technologies. The use of concessional financing from international partners, as well as other sources of funds such as climate financing can also be considered for supporting private sector engagement in the dissemination and development of technologies that require high investment costs.

5. Industry and commerce

5.1 Sectoral assessment

The industry and commerce sector is the driving force to Nigeria's industrialization and is expected to play a significant role in supporting the country's growing population. In 2020, the industry sector contributed to approximately 22 percent of Nigeria's GDP, primarily led by the oil and gas-related industries.¹⁵ In this regard, Nigeria has some of the largest oil and gas reserves in the world, accounting for over 90 percent of foreign exchange earnings and significant portion of government's revenue. The manufacturing sector is also an essential sector to Nigeria's economic growth, which is dominated by cement production that is the highest among West African countries.¹⁶ Yet, the industry sector accounted for only 3 percent of export revenues but over 50 percent of imports, spending over USD 30 billion annually on import of various manufactured goods, leading to a balance of payments deficit for the past decade.¹⁷ Therefore, it is evident that developing domestic industries in the industry and commerce sector as well as diversifying Nigeria's overall economy are crucial for Nigeria's long-term sustainable development.

Yet, the industry and commerce sector of Nigeria faces several challenges. One of the challenges in the sector is the lack of information on the latest technologies and innovation that may contribute to reducing emissions from the sector as well as enhance energy efficiency. In addition, the limited coordination among stakeholders and institutions hinders the process of implementing necessary policies and activities, including institutional and technical capacity building. Similarly, the absence of coherent standards and quality control measures has made products from the sector less competitive while keeping high level of value chain emissions. Furthermore, according to the Nigeria Industrial Revolution Plan, the lack of necessary infrastructure including insufficient supply of electric power is a major constraint for both in terms of productivity in the industry and commerce sector and the transition to a low carbon economy. Difficulty in addressing these challenges stems from the lack of financial resources, fiscal investments, and participation from the private sector.

Given the dependence on carbon-intensive industries and fossil fuels, decarbonizing the industry and commerce sector and accelerating the transition to a low carbon economy is critical in achieving Nigeria's climate change objectives. In this context, even though the Industrial Processes and Product Use (IPPU) sector alone only contributed to less than 2 percent of Nigeria's total emissions in 2017, emissions from the IPPU sector increased by approximately 5 times from year 2000 to year 2017 (2000 – 2,511 GgCO₂eq, 2017 – 11,618 GgCO₂eq). Projections estimate that GHG emissions from the IPPU sector will increase due to the development of the industry and commerce sector along with population growth. Among the sub-sectors, cement and iron and steel sub-sectors accounted for the most GHG emissions, contributing 53.4 percent and 46.4 percent of the aggregated emissions, respectively. As a result, reducing GHG emissions from the cement and iron and steel sub-sectors will be needed, along with reducing overall energy consumption in the sector.

In the agribusiness and agro-allied sub-sector, which consists of food processing, Nigeria aims to become a leading agribusiness and agro-allied industrial nation by applying technology in intensifying production across a number of agro products. Even though some of these industries may align with Nigeria's development and industrialization plan, not all identified sectors in scope directly align with climate objectives in Nigeria. In particular, industries such as sugar, palm oil processing and cocoa processing may consider sustainable agriculture measures to increase

¹⁵ Statista. 2020. Nigeria-distribution of GDP across economic sectors from 2010 to 2020

¹⁶ Transforming Energy Access. 2021. Bioenergy in cement manufacturing in Nigeria.

¹⁷ Federal Government of Nigeria. 2014. Nigeria Industrial Revolution Plan.

productivity and production of by-products. On the contrary, solid minerals and metals sub-sector significantly contributes to large scale midstream and downstream industrial activities in Nigeria, which is also an integral part of Nigeria’s economy, Similar to agribusiness and agro-allied sectors, not all sectors in scope directly support climate objectives in Nigeria, such as auto assembly, aluminum, and chemicals. However, sectors such as cement and basic metals, including blooms, billets, sheet metal, plates, bars, rods, wire, and structural frames, support the construction industry in which development of affordable housing is needed to support the growing population.

In the construction and manufacturing sector, the World Bank has identified the sector as having one of the highest potential sectors in employing youth.¹⁸ This sub-sector generally focus on construction, with emphasis on supply of housing stock and construction of buildings, and light manufacturing, such as manufacturing of consumer and home goods. The construction sector supports the development and sale of affordable housing units which will require the use of solid minerals and metals, such as cement and iron and steel. For the light manufacturing sector, these include production of electronics and home appliances, which supports climate objectives related to energy efficiency. By efficiently assembling and producing appliances such as air conditioners and refrigerators, this will also support in achieving energy efficiency.

5.2 Prioritized technologies

The industry and commerce sector is comprised of three prioritized sub-sectors, namely, agribusiness and agro-allied sector, solid minerals and metals, and construction and manufacturing. The technologies prioritized under this sector are summarized in the table below. For each sector, 2-3 technologies per sub-sector were prioritized during the validation workshop that took place on August 1st, 2022.

Agribusiness and agro-allied sector	<ul style="list-style-type: none"> 7. Modular palm oil mills 8. Anaerobic digesters
Solid minerals and metals	<ul style="list-style-type: none"> 7. Use of alternative fuels 8. Advanced grinding technologies 9. Unhydrated cement recycling
Construction and manufacturing	<ul style="list-style-type: none"> 7. Shifting to renewables sources for electricity 8. Disaster-resilient buildings 9. Zero energy buildings

5.3 Assessment of barriers

The industry and commerce sector of Nigeria faces the following barriers for the dissemination of prioritized technologies:

Types of Barriers	Description
Political	<ul style="list-style-type: none"> ▪ None
Regulatory	<ul style="list-style-type: none"> ▪ Absence of coherent standards and regulations ▪ Lack of quality control measures
Institutional	<ul style="list-style-type: none"> ▪ Insufficient coordination among the stakeholders ▪ Heavy reliance on fossil fuels
Technical	<ul style="list-style-type: none"> ▪ Lack of technical know-how on the prioritized technologies
Financial	<ul style="list-style-type: none"> ▪ Lack of financial resources ▪ High investment costs ▪ Lack of fiscal incentives to implement the technologies
Geographical	<ul style="list-style-type: none"> ▪ Limited geographical assessments

¹⁸ World Bank/IBRD/IFC (November 2018) Nigeria Systematic Country Diagnostic (SCD) Transitioning to a Middle-Class Society <https://openknowledge.worldbank.org/handle/10986/23099>

Market	▪ Limited private sector involvement
Information	▪ Lack of information on the latest technologies
Behavioral	▪ Limited understanding on the benefits of technologies

The introduction of prioritized technologies in the industry and commerce sector will require significant financial resources. This is not only needed in deploying the prioritized technologies per se, but also for meeting infrastructure requirements and promoting further investments. In addition, creating an enabling environment for introducing the technologies is necessary, especially by formulating adequate standards and regulations. For instance, environmental standards and requirements on cement production are still limited in Nigeria, which may hinder the deployment of prioritized technologies in the cement industry. Similarly, building standards that consider climate change impacts are still insufficient. Formulating regulations and standards, therefore, can incentive the industry in adopting the prioritized technologies.

To develop appropriate policies and regulations, however, coordination among stakeholders will be critical. Institutionally, the roles and responsibilities of institutions remain unclear, which has contributed to the lack of information on the latest technologies. General awareness and information regarding the technologies, especially on the benefits of each prioritized technology, need to be improved within the sector. The industry sector is poorly informed about the technology characteristics, market opportunities, as well as on their own energy use, which also encourage the industry sector to maintain its conventional methods and dependence on fossil fuels.

The spread of COVID-19 is another challenge that the industry and commerce sector is facing. According to the National Bureau of Statistics in Nigeria, the industry and commerce sector experienced negative growth rates of -12.05 percent in 2020 leading to reductions in investments.¹⁹ As a result, the industry sector has contracted by 5.9 percent over the course of 2020, with financial reports of all the sub-sectors indicating a decrease in revenue.²⁰ The financial status of the industry and commerce sector is a significant concern as it may prevent the sector's transition to low carbon production and implementing the prioritized technologies. Therefore, establishing the enabling environment, providing fiscal incentives, and disseminating appropriate information on the technologies will be essential.

5.4 Identified action plans and activities for the industry and commerce sector

The technology action plans for the prioritized technologies include the necessary activities to introduce the technologies, financing options, and monitoring and evaluation methods. The successful diffusion of the prioritized technologies and associated action plans under the industry and commerce sector will directly impact Nigeria's NDC while contributing to the country's overall development. The implementation action plans for the industry and commerce sector are as follows:

Action Plan 1: Raising awareness

Action Plan 2: Capacity building

Action Plan 3: Development of enabling environment for private sector engagement

Action Plan 4: Dissemination of technologies

The first action plan aims at raising the awareness of the relevant stakeholders such as government institutions, industrial leaders, technology developers, end-users, potential investors, and financial institutions. The objective of the second action plan is mainly to strengthen the technical and institutional capacity of relevant government institutions to allow

¹⁹ UNDP. 2021. The impact of COVID-19 on business enterprises in Nigeria

²⁰ Ibid.



them to make informed decision to design the required gender-responsive policies such as regulations, standards, fiscal instruments and incentives, among others, to support the implementation and dissemination of the technologies. The third action plan intends to develop the enabling environment for private sector stakeholders, to encourage them to take-up and scale-up the technologies and measures under each technology. Finally, as opposed to the previous three action plans which focuses on transversal measures applicable for all the technologies, the fourth action plan details the concrete activities needed to disseminate the technologies.

As for the industry and commerce sector, the financing approach will aim at attracting climate finance from international financial institutions and trigger private sector investments from the private sector by developing the enabling environment for the deployment of prioritized technologies. The first set of activities, which includes the technical and institutional capacity building of relevant stakeholders on the prioritized technologies, will be financed by international organizations or bilateral donors in the form of grants. Furthermore, concessional financing may also be leveraged for private sector stakeholders. For developing the enabling environment, even though the costs particularly associated with formulating relevant policies and regulations can be addressed through domestic resources, especially in the form of public funding, domestic sources may be limited for this purpose in Nigeria. As a result, technical assistance from international, multilateral, as well as bilateral sources can be considered. In regard to the dissemination of technologies, it is preferred that the financing will be led by the private sector, including local financial institutions to establish a sustainable business model for the prioritized technologies.

6. Cross-cutting opportunities and challenges

This section identifies cross-cutting opportunities and challenges that are available in the three prioritized sectors.

6.1 Cross-cutting opportunities

There are mainly two types of opportunities: one from a policy perspective and another from a technological perspective. From a policy perspective, developing cross-sector policies and strategies, can provide opportunities for cross-sectoral collaboration, which can in turn accelerate the implementation of the prioritized technologies. This can lead to benefits such as exchange of information and mobilization of funds, which are critical components of disseminating climate change mitigation and adaptation technologies. Moreover, consolidated frameworks or policies for cross-sectoral cooperation is not only important in addressing climate change impacts, but also to achieving sustainable development. On the other hand, from a technological perspective, several technologies can be implemented across sectors, enhancing the opportunity for the technologies to be deployed at a larger scale. Technologies such as climate smart agriculture, waste to energy, and alternative fuels, have cross-sectoral opportunities. For instance, it may be beneficial for deploying energy management systems into climate smart agriculture practices, to reduce the agricultural sector's reliance on fossil fuels. Synergies between energy and industry and commerce sectors are also possible, such as by installing carbon capture and storage into hard-to-abate sectors like cement, iron and steel industries, and utilizing the electricity produced from renewable industry in the commerce sector. These technological opportunities can have both climate change mitigation and adaptation benefits, which in turn can contribute to achieving Nigeria's climate change targets. Furthermore, projects or initiatives with cross-sectoral impacts are more likely to attract international finance, which can address the issue of limited budget in disseminating the prioritized technologies.

6.2 Cross-cutting challenges

According to the evaluation of barriers for each sector, there are four main barriers that are evident across all sectors: (a) institutional and stakeholder coordination, (b) information on the technologies, (c) technical capacity and know-how, and (d) financial resources. Firstly, limited collaboration and coordination among institutions and stakeholders has hindered the deployment of climate change mitigation and adaptation technologies in each sector, and thus Action Plans 1, 2, and 3 for each sector incorporate activities to address this issue. This issue has been raised by the stakeholders during the stakeholder consultations as well as the regional workshops. In particular, due to the limited coordination among relevant ministries, information exchange has been insufficient. Secondly, information on many of the prioritized technologies are still limited in Nigeria, which has been a barrier in disseminating these technologies. This is especially the case for technologies that has yet been introduced in Nigeria, such as unhydrated cement recycling and zero energy building. As a result, Action Plan 1 specifically focuses on awareness raising activities to disseminate information on the prioritized technologies among relevant stakeholders. Thirdly, given the limited information on the prioritized technologies and coordination among stakeholders, insufficient technical capacity of relevant stakeholders and institutions as well as limited human resources are major barriers in developing and implementing certain climate change mitigation and adaptation technologies. This issue is evident for technologies that have not been deployed in Nigeria. As such, Action Plan 2 for each sector addresses this issue and incorporate activities that leads to the enhancement of technical capacities of relevant stakeholders. Finally, an obvious barrier to the application of any technology is the insufficient amount of capital that is needed to successfully implement the technologies. This is not only limited to the initial investment required to deploy the prioritized technologies, but also the capital used for operation and maintenance of the technologies. Given the limited budget of the Nigerian government to address this and the significance of this issue, financial options are considered in



detail in the TAPs. Implementing the associated action plans and addressing these barriers, therefore, is critical in not only implementing the prioritized technologies, but also to help Nigeria to achieve its climate change mitigation and adaptation objectives.